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Recognizing Spontaneous Facial Expressions of Emotion in a Small-Scale Society of Papua New Guinea

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Abstract

We report two studies on how residents of Papua New Guinea interpret facial expressions produced spontaneously by other residents of Papua New Guinea. Members of a small-scale indigenous society, Trobrianders (Milne Bay Province; $N = 32$, 14 to 17 years) were shown 5 facial expressions spontaneously produced by members of another small-scale indigenous society, Fore (Eastern Highlands Province) that Ekman had photographed, labeled, and published in The Face of Man (1980), each as an expression of a basic emotion: happiness, sadness, anger, surprise, and disgust. Trobrianders were asked to use any word they wanted to describe how each person shown felt and to provide valence and arousal ratings. Other Trobrianders ($N = 24$, 12 to 14 years) were shown the same photographs but asked to choose their response from a short list. In both studies, agreement with Ekman's predicted labels was low: 0 to 16% and 13 to 38% of observers, respectively.

Keywords: spontaneous facial expressions; indigenous societies; emotion perception; cross-cultural diversity; universality thesis

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Of extreme importance in the science of emotion has been a series of studies of facial expressions conducted in Papua New Guinea (Ekman, 1972; Ekman & Friesen, 1971; Ekman, Sorenson, & Friesen, 1969; Sorenson, 1975, 1976). By purporting to demonstrate that certain facial expressions convey to Papua New Guineans the same emotions they convey to Westerners, these studies inspired a research program on the universality of facial expressions and of emotions more generally, resurrected an interest in Darwin's analysis of facial expression, provided tools for neuroscience, and inspired applications from tests of emotional intelligence to emotion regulation to techniques for border security (Leys, 2010; Plamper, 2015). Debate has ensued over the empirical results from studies of facial expressions and over the conceptual framework—Basic Emotion Theory—undergirding that research and application (Crivelli, Jarillo, Russell, & Fernández-Dols, 2016; Ekman, 1994, 2003, 2016; Ekman & Cordaro, 2011; Jack, Blais, Scheepers, Schyns, & Caldara, 2009; Levenson, 2011). All the same, according to a survey conducted in 2014, over 80% of emotion researchers surveyed accepted the conclusion drawn from the original studies in Papua New Guinea: certain facial expressions convey basic emotions universally (Ekman, 2016)—a conclusion often presented in psychology textbooks (Gilovich, Keltner, & Nisbett, 2011; Myers & DeWall, 2015; Schacter, Gilbert, & Wegner, 2011). In this article, we report two studies that challenge that conclusion.

The studies conducted in Papua New Guinea (Ekman, 1972; Ekman & Friesen, 1971; Ekman, Sorenson, & Friesen, 1969; Sorenson, 1975, 1976) have received various criticisms (Russell, 1994; but see Ekman, 1994; Izard, 1994; Russell, 1995). Key

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criticisms concern the methodological choices made when designing those studies.

First, one of the original researchers pointed to ways in which the Papua New Guinean observers might have been influenced by the translators who helped conduct the studies (Sorenson, 1975, 1976).

Second, responses by the Papua New Guinean observers were gathered with a multiple-choice format. When observers select the predicted option from a limited set, they might not be indicating an automatic "decoding" of the meaning "encoded" in a signal, but only which is the best of the options available. Rather than "recognizing" a specific emotion from the facial expression, they might narrow their choices through a process of elimination (DiGirolamo & Russell, 2016; Nelson & Russell, 2016) or on the basis of broad affective dimensions such as valence and arousal (Russell, 1997, 2003; Yik, Widen, & Russell, 2013). Such speculations are reinforced by studies that used a more open-ended response format in Western (Izard, 1971), Eastern (Haidt & Keltner, 1999), and pastoralist African samples (Gendron, Roberson, van der Vyver, & Barrett, 2014); these studies found lower amounts of recognition of emotion from the face than is typically found with multiple-choice formats. Sorenson (1975) used a free labeling format with observers from Papua New Guinea. For the hunter-gatherers Fore with least contact with Westerners, the amount of recognition was low for disgust, contempt, sadness (< 26%), modest for fear and surprise (33%), moderate for anger (51%), and high for happiness (87%). Open-ended formats can be criticized for their reliance on the observer having the needed term readily available. In short, multiple-choice formats might overestimate the amount of agreement with the experimenter's prediction, but more open-ended formats might underestimate the amount. In the present study, we explored both types of format.

And, third, the facial expressions presented to the Papua New Guinean observers

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were all *posed*. Posed expressions were deliberately designed to convey one and only one emotion, and the photographs shown to observers had been selected as the ones most successful at doing so. Studies of recognition of emotion from spontaneously produced facial expressions have found substantially less agreement on the emotion conveyed (Hess & Blairy, 2001; Kayyal & Russell, 2013; Naab & Russell, 2007; Wagner, MacDonald, & Manstead, 1986).

During his visits to Papua New Guinea in the 1960s, Paul Ekman photographed facial expressions produced *spontaneously*. They were produced by a group of hunter-gatherers—the Fore of the Eastern Highlands—who had no knowledge of the uses of a camera and therefore cannot be said to be camera-shy. As in most nonindustrialized, small-scales societies, Fore lives were lived in hamlets in a communal fashion (Sorenson, 1976; Sorenson et al., 1972). So, Fore everyday life was easily observed and photographed. In 1980, Ekman published a set of these photographs. Ekman knew the individuals he photographed, their situation, and their behavior. Based on this information and on the facial muscle movements visible on the face, Ekman specified the emotions conveyed by the faces he photographed.

Two studies exploited this valuable archive of photographs by showing them to Western observers who were asked what emotions were being expressed (Kayyal & Russell, 2013; Naab & Russell, 2007). Responses failed to match Ekman's predictions at the level anticipated. For example, fewer than 30% of English-speaking United States (U.S.) Americans, English-speaking Palestinians, and Arabic-speaking Palestinians, on average, selected the predicted emotion (Kayyal & Russell, 2013). This result is far from what was thought needed to support universality. Haidt and Keltner (1999) specified that to support the claim of universal recognition, 70-90% of responses should match the prediction. A possible explanation for the low amount of recognition,

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however, is the phenomenon of in-group bias (Elfenbein, 2013). Expressions are better recognized by members of groups more similar to those who produced the expressions. Here we report two studies on how residents of Papua New Guinea interpret the facial expressions that Ekman (1980) photographed in Papua New Guinea.

The Present Studies

Here we report two studies testing the claim of universal recognition by showing Ekman's (1980) photographs of the Fore taken nearly a half of a century ago to observers from another small-scale society in Papua New Guinea. Our observers came from a different ethnic group—the Trobrianders, a group of subsistence fishermen and horticulturalists living in a small archipelago located in the Solomon Sea and approximately 200 km east of mainland Papua New Guinea (Leach & Leach, 1983; Malinowski, 1929/1969, 1935/1965; Young, 1998). Trobrianders live in small villages built with trees, palms, and coconut fronds. In the Trobriand Islands, there is no electricity, no running water, no sewers, and limited medical assistance (for a more detailed description of the Trobrianders, see Crivelli, Jarillo, Russell, & Fernández-Dols, 2016). Because of ethnic differences, our study is best considered a within-nation rather than within-culture comparison (Ojalehto & Medin, 2015).

In the first study, Trobrianders were shown five of Ekman's photographs each purported to show an expression of a single basic emotion. Trobrianders were asked to use any word they wanted to describe how each person shown felt and to provide valence and arousal ratings. The second study was carried out to clarify the results of the first with a different and literate sample of Trobrianders. The experimenter showed the same five spontaneous facial expressions, but this time forced participants to choose among specified labels from a short list.

Both studies were conducted entirely in Trobrianders's vernacular, Kilivila (see

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Fellows, 1901; Senft, 1986, 2010), a language that the experimenter speaks fluently. Kilivila—which belongs to the Austronesian family, Papuan tip cluster—is spoken exclusively in the archipelago, whereas *Tok Pisin* (the Papua New Guinea lingua franca) is completely unheard of in the Trobriand Islands. Elementary schoolchildren (5-9 years old) use exclusively their vernacular during classes and are instructed in Trobriand culture such as environmental knowledge (e.g., names of botanical and animal species) or traditional folklore (e.g., dancing and singing). Despite significant governmental efforts to introduce English as the common language, alphabetization attempts have resulted in a slow switch from oral to written Kilivila. It is not until students reach primary school (10-16 years old) that they learn how to spell, read, and write in their vernacular. Schools in the Trobriand Islands lack sufficient teachers, infrastructure, and basic facilities, resulting in students' loss of interest and high dropout rate. For the convenience of the reader, we describe the studies as if they were conducted in English, with only occasional translations into Kilivila.

Study 1: Free Labeling

The language of the Trobrianders includes commonly used and understood terms that are approximate translations of Ekman's (1980) predictions: happiness (*mwasawa*) for the smiling face, sadness (*ninamwau*) for the pouting face, anger (*leya*) for the scowling face, surprise (*eyowa lopola*) for the brow raiser face, and disgust (*minena*) for the nose scrunching face. Trobriand emotion concepts are not exact translations of, but greatly overlap with, their English counterparts. Indeed, emotion terms generally lack exact translation from one language to another (e.g., Kollareth & Russell, 2016; Wierzbicka, 2014). For example, *eyowa lopola* (literally, his or her insides have jumped) implies fast timing, little cognitive elaboration, and neutral valence, whereas *ekau nanogu* (literally, it has taken my mind) suggests more cognitive

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elaboration and positive valence; both phrases were scored as a correct response for the surprise face.

Method

Participants. Thirty-two adolescents (*M* age = 14.84, *SE* = 0.14, age range: 14-17 years old; 17 male) were recruited in Kaduwaga (*n* = 12) and Vakuta (*n* = 20) villages (Trobriand Islands, Milne Bay Province, Papua New Guinea). Instruction in English usually begins around age 10-12 years. Twenty-six of the participants could understand and speak some English, with proficiency ranging from understanding a few words to the production and understanding of some simple sentences.

Facial expressions. Five spontaneous facial expressions of emotion—happiness, sadness, anger, surprise, and disgust—produced by the Fore people (Eastern Highlands Province, Papua New Guinea) were selected from a set of 68 photographs published by Ekman (1980). We selected the five facial expressions based on two criteria: (a) they showed a clear and frontal view of the face, and (b) Ekman (1980) assigned to the expression a single label for a basic emotion. Each facial expression was also coded with the facial action coding system (Ekman, Friesen, & Hager, 2002); see Appendix, Table A1. Images were formatted with a similar size (average size 7.4 cm X 5.2 cm) and laminated.

Procedure. The study was carried out during class time to avoid leaking of information. Participants arrived sequentially to an isolated testing area to be tested individually. In a preliminary step, the experimenter ascertained that each participant was able to make quantitative judgments on a 4-point ordinal scale. The participant saw four cards with different quantities of fish (none, 3, 9, and 18 fish) and was asked to touch the card that had no (*gala*), some (*pikekita*), a lot (*bidubadu*), or all (*sena bidubadu*) the fish. All participants successfully passed this test.

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Next, the experimenter showed the participant one of the faces selected randomly from the set of five and asked, "What does the person in the picture feel?" The experimenter asked the participant to provide only one descriptor for the face or to answer, "I don't know" if they really didn't know. In the event that the participant provided more than one descriptor, the experimenter asked for the single best descriptor. In the event that the participant described the face with only a general positive or negative label (e.g., feeling bad) or described the face on a general arousal dimension (e.g., sleepy), the experimenter asked for a more specific descriptor. These procedures were crafted to nudge the participant toward providing a term for a discrete emotion (or at least a discrete feeling), but without forcing them to do so and without hinting just which emotion was expected. All the same, despite these nudges, the participant had the final word on what label was taken as his or her response.

Next, for the same facial expression, the experimenter asked for a judgment of the core affect—the broad dimensions of valence and arousal (Russell, 1980, 2003)—the face expressed. The experimenter first asked participants whether the person was feeling good (*bwena*) or bad (*gaga*). The dichotomous choice was followed by a request for an intensity rating. For example, for a face that had been judged to be feeling good, the experimenter asked the participant, "Is he feeling a little good (*pikekita bwena*)? very good (*sena bwena*)? or extremely good (*kena sena bidubadu bwena*)?" In the same vein, the experimenter asked whether the person was feeling sleepy (*enunupila matala*) or aroused (*emamata*) followed by an intensity judgment. For example, for a face judged to be aroused, the experimenter asked the participant, "Is he a little bit aroused (*pikekita emamata*)? very aroused (*sena emamata*)? or extremely aroused (*sena bidubadu emamata*)?"

This procedure was then repeated for each of the remaining faces. The order of

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presentation of the faces was randomized separately for each participant.

Translation of responses. The experimenter's knowledge of the vernacular helped to translate Kilivila responses into English (Crivelli, Jarillo, & Fridlund, 2016; Crivelli, Jarillo, Russell, & Fernández-Dols, 2016; Fernández-Dols & Crivelli, 2014). Additionally, we relied on an ethnographic database of Trobrianders' emotion concepts generated in several islands of the archipelago with the help of mono- and bilingual informants (for an analysis of emotion concepts in Trobrianders' vernacular, see Senft, 1986, 1998). Following a liberal approach, we grouped together several labels into a broader category (see the Appendix, Table A2). In some cases, dialectal differences justified the grouping of labels. For example, *bwena*—translated as good—is used in all islands of the Trobriand archipelago except in Vakuta Island where *boina* is used instead. In other cases, we grouped together labels derived from the same root. For example, *togigila* (translated as a laughing man) is the result of adding the nominal classificatory prefix *to-* (i.e., a human male) with *gigila* (laughter).

Scoring and data analysis. Every participant provided one label or said, "I don't know," per trial. Data analyses were performed with R (Kabacoff, 2015; R Core Team, 2014), using functions in different packages. In order to assess whether or not the distribution of labels generated was uniform, we performed chi-square goodness-of-fit tests for the distribution of label's frequencies within every facial expression. In order to test whether any given label would be dubbed "characteristic" for certain facial display, we obtained *p* vales and standardized residuals by bootstrapping 10,000 replicates for simulation. Labels with standardized residuals higher than 2 *SD* will show a significantly displacement of cases towards that category and, eventually, it will show that the label is the most characteristic for that facial expression (Agresti, 2013).

To convert the core affect responses to a quantitative score, participant's initial

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dichotomous response was used to determine the score's sign: positive valence/aroused received a positive score, negative valence/sleepy a negative score, and "I don't know" a score of zero. The intensity judgment then was assigned a number from 1 to 3. Final scores thus ranged from -3 to +3. As it happens, no participant said, "I don't know."

Results

Labels. The labels generated for each facial expression, along with the proportion of participants who gave that label, is shown in Table 1. A fuller list with all labels for all faces and the frequency of occurrence is provided in the Appendix (Table A2).

The emotion labels predicted by Ekman (1980) occurred, but rarely. For no face did a majority of Trobrianders produce the predicted label. For no face was the predicted label modal. The mean proportion responding with the predicted label across the five facial expressions was .08 (95% CI [.04, .13]). The highest proportion occurred for face predicted to convey sadness (.16, 95% CI [.06, .32]). Lower values occurred for the happy (.13, 95% CI [.04, .29]), disgust (.06, 95% CI [.01, .21]), and anger (.03, 95% CI [.00, .17]) faces. For the surprised face, no Trobriander provided the expected label or labels closely related to the expected label (*ekau nanogu*, *eyowa lopola*).

The data provided other indications that the Trobianders did not see a one-to-one correspondence between the face and the predicted emotion. Thus, the predicted label (*ninamwau*, sadness) provided for the sad face (.16) was also provided for surprised (.16), disgusted (.09), and angry (.06) faces, but never for the happy face. A possible interpretation of the .16 "correct" labeling of the sad face is therefore that the label *ninamwau* was simply used more frequently than other labels for negative faces. Altogether, the label *ninamwau* was used more often for some "incorrect" face than for the "correct" one.

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The modal labels were unexpected: *gigila* (laughing, smiling) and *gibulwa* (feels like avoiding social interaction). *Gigila* was modal for the happy face (.44, 95% CI [.28, .61]), $\chi^2 = 21.69$, $p < .0001$. *Gibulwa* was modal for the other four faces: the sad face (.22, 95% CI [.11, .39]), angry face (.56, 95% CI [.39 .72]), surprised face (.19, 95% CI [.09, .36]), and disgusted face (.22, 95% CI [.11, .39]). *Gibulwa* was thus a general term, but most characteristic for the angry face and not equally distributed across the four faces for which it was modal, $\chi^2 = 36.89$, $p < .0001$. It might be argued that *gigila* should be counted as correct for the happy face, *gibulwa* for the angry face. We postpone discussion of that argument until the General Discussion section.

We also found that, despite our urgings, some Trobrianders did not produce a label for the emotion expressed by three of the five facial expressions. "I don't know" was the second modal category for the sad (.19) and disgusted (.19) faces and the third modal category for the surprised face (.16).

Dimensions of core affect. Figure 1 shows Trobrianders' mean ratings for each face on the valence and arousal dimensions. Friedman tests showed significant differences across faces in valence, $\chi^2(4, N = 32) = 68.68$, $p < .001$, and arousal, $\chi^2(4, N = 32) = 46.23$, $p < .001$. For valence, Trobrianders attributed pleasure to the happy face ($M = 1.38$, $SE = 0.33$), and displeasure to the sad ($M = -0.53$, $SE = 0.31$), angry ($M = -1.25$, $SE = 0.27$), surprised ($M = -0.91$, $SE = 0.29$), and disgusted ($M = -2.94$, $SE = 0.04$) faces. For arousal, Trobrianders attributed high arousal to the happy ($M = 1.06$, $SE = 0.31$), sad ($M = 1.44$, $SE = 0.22$), angry ($M = 2.13$, $SE = 0.21$), and surprised ($M = 1.38$, $SE = 0.25$) faces and low arousal to the disgusted face ($M = -1.31$, $SE = 0.32$).

For comparison purposes, we relied on a sample of participants from the United States who had rated the five facial expressions on the core affect dimensions with bipolar 7-point Likert scales (Kayyal & Russell, 2013). We turned all ratings into

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dichotomous scores (Table 2). A majority of Trobrianders and U.S. Americans had the same dominant dichotomous valence score for all 5 faces and the same dominant dichotomous arousal score for 4 of 5 faces. The one case of disagreement was the disgusted face's arousal ratings. Only a small proportion of Trobrianders considered the disgusted face as highly activated (.19, 95% CI [.09, .36]), whereas a majority of U.S. Americans did (.80, 95% CI [.66, .89]), $\chi^2(1, N = 77) = 25.88$, $p < .001$, 95% CI [-.76, -.40].

The proportion of Trobrianders' attributions of positive or negative valence and high or low arousal was similar but not identical to U.S. Americans' attributions. Significantly more Trobrianders than U.S. Americans rated sad, angry, and surprised faces as aroused (see Table 2). A two-sample test for equality of proportions showed the former difference in the proportion of Trobrianders' and U.S. Americans' attributions of high arousal; for sad faces, $\chi^2(1, N = 78) = 5.36$, $p = .021$, 95% CI [.07, .44]; angry faces, $\chi^2(1, N = 78) = 11.14$, $p < .001$, 95% CI [.19, .53]; and surprise faces, $\chi^2(1, N = 72) = 7.38$, $p = .007$, 95% CI [.12, .51].

Discussion

Shown spontaneous facial expressions produced by the Fore (Eastern Highlands Province, Papua New Guinea), Trobrianders (Milne Bay Province, Papua New Guinea) responded easily and with confidence. They occasionally produced the emotion labels predicted by Ekman (1980). For three out of the five faces, however, despite our urgings, almost 20% of Trobrianders stated that they did not know which emotion was displayed, whereas, when asked about the dimensions of core affect, no Trobriander said, "I don't know."

Ekman's predicted labels were rare, provided for four of the five faces by a small proportion of respondents (the highest proportion was .16). Further, the predicted

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labels were also offered for the "wrong" face for four of the five faces. Trobrianders' more frequent responses were *gigila* (laughing, smiling) for the happy face and *gibulwa* (feeling like avoiding social interaction) for the sad, angry, surprised, and disgusted faces.

Trobrianders also showed a significant overlap with U.S. Americans judging the dimensions of core affect for the same faces. These data suggest that Trobrianders may share with Westerners a process of interpreting facial expressions based on valence and arousal—a process seen even in children of both Western (Kayyal & Russell, 2013; Widen, 2013; Widen & Russell, 2008, 2010) and small-scale, indigenous societies (Crivelli, Jarillo, Russell, & Fernández-Dols, 2016).

Study 2: Multiple Choice

Study 2 was designed to complement Study 1 in its focus on the same five Fore spontaneous facial expressions. It might be argued that Study 1's open-ended response format was too open. Haidt and Keltner (1999) provided evidence that open-ended response formats tend to show less agreement, whereas more constrained response formats are more likely to support predictions from Basic Emotion Theory. Therefore, multiple-choice response formats have often been used and recommended (e.g., ; Boucher & Carlson, 1980; Ekman & Friesen, 1971).

Specifically, Study 2 addressed two issues. First, perhaps the predicted emotion label did not come to mind, but would be endorsed if it were made available. We therefore used here the common forced-choice response format that included all the predicted labels. Frank and Stennett (2001) showed that adding certain alternatives enhanced the performance of a forced-choice format. Here, we added two, one for any emotion not listed and one for not knowing the meaning of the face. Second, in Study 1, participants had frequently used two unexpected labels: a word for a behavior, *gigila*

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(laughing, smiling), and a general emotion term, *gibulwa* (feeling like avoiding social interaction). Perhaps these labels were used only because the predicted labels did not come to mind. Do the Trobrianders genuinely prefer these labels when Ekman's (1980) predicted labels are also available?

The method of Study 2 was similar to that of Study 1, with two major exceptions. First, the response format required respondents to choose one among Ekman's (1980) predicted emotion labels, two modal terms found in Study 1, *itwali* (other [emotion]) and *gala anukwali* (I do not know). Second, to ensure that all response options were clear and available, we recruited a sample of literate Trobrianders who read the response options from a list.

Method

Participants. Twenty-nine adolescents, who had not participated in Study 1, were recruited in Vakuta Island. We excluded five of these adolescents (2 male) who failed our test of literacy (see below). The final sample thus consisted of 24 literate adolescents (*M* age = 12.96, *SE* = 0.11, age range: 12-14 years old; 13 male). Twenty of them could understand and speak some English words.

Facial expressions. The same set of faces used in Study 1 were used in Study 2 (see the Appendix, Table A1).

Response format. The response format consisted of nine written terms. Five of the labels were predicted by Ekman (1980): *mwasawa* (happiness), *ninamwau* (sadness), *leya* (anger), *eyowa lopola* (surprise, startle), and *minena* (disgust). Two of the labels were Study 1's modal categories: *gigila* (laughing, smiling) and *gibulwa* (feels like avoiding social interaction). And, two of the remaining labels were *itwali* (other emotion) and *gala anukwali* (I do not know). On the actual questionnaire, only the Kilivila terms were listed. The items were always presented in the same order:

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gilbuwa, *ninamwau*/*mwau*, *minena*, *eyowa lopola*, *gigila*, *leya*, *mwasawa*, *itwali*, and *gala anukwali*.

Literacy test. To be eligible for Study 2, Trobrianders had to pass a literacy test. The experimenter handed each potential participant a written list with all the response options, which they were asked to read aloud twice. Then, they were asked whether they understood the meaning of all the labels. All but five potential participants passed the test. The five (2 males) who failed the test were dismissed from the study but rewarded with candy. Thus, all actual participants could read the list and reported that they understood the meaning of all the labels.

Procedure. The procedure was the same as in Study 1 except as follows. For every trial, the participant was asked to read, once again, the entire list of labels before selecting one for the face shown.

Scoring and data analysis. Data analyses were performed with R (Kabacoff, 2015; R Core Team, 2014). For computing a Cochran tests on the proportions of Table 3's main diagonal we used the "coin" package (Hothorn, Hornik, van de Wiel, & Zeileis, 2008); for binomial tests we used the "binom" package (Dorai-Raj, 2014) and we relied on Agresti-Coull's method for estimating 95% CIs (Agresti & Coull, 1998).

Results

Ekman's predicted labels. The overall mean proportion of Trobrianders who selected Ekman's (1980) predicted emotion label for the predicted face was .23 (95% CI [.17, .32]). Proportions "correct" (i.e., matching prediction) were low and similar across faces. The highest "correct" proportion occurred for the disgust face (.38, 95% CI [.21, .57]), followed by the sad face (.29, 95% CI [.15, .49]), surprise face (.21, 95% CI [.09, .41]), happy face (.17, 95% CI [.06, .37]), and angry face (.13, 95% CI [.04, .32]). The similarity of proportions for different faces seen in the overlapping of the 95% CIs was

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confirmed by a Cochran's Q test for matched samples applied to Table 3's main diagonal proportions, $\chi^2(4, N = 24) = 5.8, p = .215$.

Some researchers have compared the obtained "correct" proportion against a theoretical proportion set to rule out guessing. In Study 2, if the participants had selected from the nine options completely randomly, then the cutoff value to rule out guessing would be .11. Only two of Ekman's predicted labels, *ninamwau* (sadness) and *minena* (disgust), significantly exceeded this cutoff value by an exact right unilateral binomial test (all *p*s < .013).

On the contrary, Study 1's modal label *gigila* (laughing, smiling) was consistently selected as the most characteristic label for the happy face (.67, 95% CI [.47, .82]), $\chi^2 = 81.75, p < .001$. *Gibulwa* (feels like avoiding social interaction) was the modal label for the angry face (.50, 95% CI [.31, .69]) and the disgusted face (.33, 95% CI [.18, .53]). Exact right unilateral binomial tests ruled out guessing (all *p*s < .004).

Misattributions. Trobrianders also occasionally selected an "incorrect" emotion label for a face even when the "correct" label was on the list. For example, .29 of respondents selected *ninamwau* (sad) for the sad face, but the same proportion of respondents selected *ninamwau* (sad) for the angry face. Indeed, every one of Ekman's predicted labels was "misattributed" to an "incorrect" face, and every face received one of the "incorrect" labels from the set of five Ekman labels. McNemar tests for giving probabilities were computed with simulated *p* values based on 10,000 replicates in order to test the distribution of emotion labels across all faces (Table 4). We found misattributions of Ekman's predicted labels across all five facial expressions, except for the label *minena* (disgust), which showed no misattribution. The label *mwasawa* (happiness) was attributed to both happy (.17) and surprised (.13) faces; the label *ninamwau* (sadness) was attributed to happy (.13), sad (.29), angry (.29), and surprised

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(.21) faces; the label *leya* (anger) was attributed to sad (.17), angry (.13), and disgusted (.13) faces; and the label *eyowa lopola* (surprise) was attributed to sad (.17) and surprised (.21) faces.

Study 1's modal labels. The modal labels from Study 1, *gigila* and *gibulwa*, were also chosen, even though Ekman's predicted labels were available on the response list. The label *gigila* (laughing, smiling) was matched to the happy face by a majority of respondents. The label *gibulwa* (feeling like avoiding social interaction) was modal for the angry face and selected for all the faces (sad, angry, surprised, and disgusted) except the happy one. The results with *gibulwa* mirrored the role of the valence dimension seen in Study 1 (see Figure 1).

Trobrianders did not prefer Ekman's predicted labels over the two modal labels seen in Study 1. A two-sample permutation test on the number of times Trobrianders matched faces to Ekman's (1980) predictions or Study 1's modal labels was used to validate Study 1's results. In the present study, Trobrianders selected *gigila* (laughing, smiling) significantly more times than *mwasawa* (happiness) for the happy face, p = .001, 95% CI [-.77, -.25]. They selected *gibulwa* (feeling like avoiding social interaction) significantly more times than *leya* (anger) for the angry face, p = .011, 95% CI [-.64, -.11]. For the remaining three faces—sad, surprised, and disgusted—matching scores' proportions did not differ significantly between Ekman's predictions and the two modal labels of Study 1 (Table 5).

Discussion

Change of response format from free labeling to multiple choice had only subtle effects on the resulting portrait of Trobrianders' interpretation of facial expressions. Contrary to Study 1, here only .06 of overall responses were "I don't know." Ekman's (1980) predicted labels continued to fare poorly. Although Ekman's predicted emotion

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label was modal for three of the five faces, in no case did a majority of Trobrianders select that label. In the remaining two cases (happy and angry faces), the modal label was the same as in Study 1. For disgusted faces, Ekman's (1980) and Study 1's predictions were not significantly different. Ekman's (1980) predictions are also challenged by the large number of misattributions.

In contrast, Study 1's modal label for the happy face, *gigila* (laughing, smiling), was similarly attributed to the happy face in Study 2. Likewise, Study 1's modal label for sad, angry, surprised, and disgusted faces, *gibulwa* (feeling like avoiding social interaction), was matched to the same faces in Study 2.

General Discussion and Conclusion

The facial stimuli studied here were a unique set of expressions spontaneously produced by hunter-gatherers living in the Eastern Highlands of Papua New Guinea, relatively isolated from the West and unaware of the uses of a camera at the time the photographs were taken. Paul Ekman (1980) had taken the photographs, knew the individuals, their situations, and their behavior. Based on this information and on the facial muscle movements visible on the face, Ekman specified the emotion conveyed by the faces we studied. The emotion attributed to the face within Basic Emotion Theory can also be seen in coding by the facial action coding system (Ekman, Friesen, & Hager, 2002).

Despite the importance of the classic facial expression studies in Papua New Guinea, ours is the first study of Papua New Guineans interpreting facial expressions spontaneously produced by other Papua New Guineans. The participants studied here, Trobrianders, were also relatively culturally and visually isolated not only from Western and Eastern industrialized countries but from other provinces of Papua New Guinea as well.

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Trobrianders did occasionally select Ekman's predicted labels in an open-ended free labeling procedure and in a multiple-choice response format. Still, the overall pattern of responding was not highly supportive of the predictions of Basic Emotion Theory. Haidt and Keltner (1999) had set 70% to 90% agreement on the predicted label as their expected level of support of the Basic Emotion Theory. Here, this amount of agreement was never achieved. With forced choice, agreement with Ekman's prediction was consistently low, ranging from 13% to 38% of respondents. With free labeling, agreement ranged from 0% to 16%. Further, Ekman's predicted emotion labels were often chosen for the "wrong" facial expression.

Free labeling and multiple-choice response format each have advantages and disadvantages and are best viewed as complementary. Free labeling captures the spontaneously produced categorization of the face but may underestimate agreement with prediction because respondents did not have the needed word readily available. Forced choice, in contrast, may overestimate agreement with prediction because respondents indicate only which option is best among those listed, but possibly not their spontaneous interpretation.

The limitations of the present study are largely obvious. One limitation of any cross-cultural comparison stems from problems in translation. Emotion terms in different languages do not translate one-to-one (Wierzbicka, 1999, 2014). Translation is more of a problem for free labeling than for multiple choice. It might be argued that more terms freely generated should have been counted as correct for Ekman's predictions. All terms, other than idiosyncratic ones, generated for each facial expression are listed in the Appendix (Table A2), and the reader can rescore. For example, one might argue that *gigila* (i.e., laughter, giggle, smile) should be counted as a synonym of happy. Ethnographic and ethnolinguistic data, however, indicate that

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gigila is not a synonym of happy (Fellows, 1901; Senft, 1986). *Gigila* refers to a behavior and does not imply happiness. Trobrianders have a different word for happiness, *mwasawa*. Further, in Study 2, when respondents were forced to choose, 17% chose *mwasawa,* and 67% chose *gigila,* for the "happy face." Similarly, one might argue that *gibulwa* should be counted as correct for the anger face. But Kilivila has a word for anger (*leya*), and *gibulwa* is not its synonym. *Gibulwa* expresses a more general feeling (feels like avoiding social interaction) and was selected for all faces (sad, angry, surprised, and disgusted) except the happy one.

Results from both of our studies suggested that the broad dimensions of core affect played a role in the interpretation of faces by the Trobrianders. When a core affect interpretation of faces was assessed directly, Trobrianders largely agreed with Westerners' interpretation on valence for all 5 faces, and on arousal for four of five faces. Further, use of *gigila* and *gibulwa* was consistent with a valence interpretation: *gigila* was used only for the happy face, *gibulwa* for all negative facial expressions. Still, core affect is clearly only a part of the interpretation placed on the faces.

Our two studies were designed to test a prediction from Basic Emotion Theory and, secondarily, from Core Affect Theory. They were not designed to test other theories, nor did they. All the same, the results do suggest that other theories merit attention. The frequent use of *gibulwa* suggests that social messages were a part of the interpretation Trobriander respondents placed on facial movements, even when directly compared with emotion messages. This finding resonates with Fridlund's (1994) Behavioral Ecology Theory based on evolutionary considerations. This finding also resonates with Frijda and Tcherkassof's (1997) theory that facial expressions convey action intentions. The contrast between the older findings of Ekman and Friesen (1971) with the Fore and our findings with Trobrianders resonates with Elfenbein's (2013)

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theory of dialects of facial expressions. Perhaps residents of Papua New Guinea have different dialects in their facial communication. More generally, the present findings suggest that we need to reopen the discussion on the production and interpretation of facial movements and encourage theories of all sorts.

It is customary at this point to say how nice it would be to have more data from more groups on more faces. Perhaps. But much evidence confirms that both core affect and Basic Emotion Theory provide at best only a first rough approximation of an account of how people make sense of the facial expressions of others. Attempts to test a Basic Emotion Theory account of facial expressions with the same methods appear to be producing diminishing returns. Our results invite the development of new methods, but also new theories that seek a better understanding of facial expressions and their interpretation. Such theories could suggest new categories of facial movements, new messages conveyed by those faces, and new processes by which facial movements are produced and interpreted—and hence might breathe new life into this field.

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Author contributions

CC, JMFD, and JAR developed the study concept. All authors contributed to the study design. CC performed data collection. All authors performed the data analysis and contributed to the interpretation of the results. CC and JAR drafted the paper, whereas JMFD and SJ provided critical revisions. All authors approved the final version of the paper for submission.

doi: 10.1037/emo0000236

References

Agresti, A. (2013). *Categorical data analysis* (3rd ed.). Hoboken, NJ: Wiley.

Agresti, A., & Coull, B. A. (1998). Approximate is better tan "exact" for interval estimation of binomial proportions. *The American Statistician, 52*, 119-226.

Boucher, J. D., & Carlson, G. E. (1980). Recognition of facial expression in three cultures. *Journal of Cross-Cultural Psychology, 11*, 263-280.

Crivelli, C., Jarillo, S., & Fridlund, A. J. (2016). A multidisciplinary approach to research in small-scale societies: Emotions and facial expressions in the field. *Frontiers in Psychology*, *7*:1073.

Crivelli, C., Jarillo, S., Russell, J. A., & Fernández-Dols, J. M. (2016). Reading emotions from faces in two indigenous societies. *Journal of Experimental Psychology: General*, *145*, 830-843.

DiGirolamo, M. A., & Russell, J. A. (2016). *The emotion seen in a face can be a methodological artifact: The process of elimination hypothesis*. [Manuscript submitted for publication].

Dorai-Raj, S. (2014). *binom: Binomial confidence intervals for several parameterizations*. Retrieved from http://cran.r-project.org/package=binom

Ekman, P. (1972). Universal and cultural differences in facial expressions of emotion. In J. R. Cole (Ed.), *Nebraska Symposium on Motivation* (Vol. 19, pp. 207-283). Lincoln, NE: Nebraska University Press.

Ekman, P. (1980). *The face of man*. New York, NY: Garland.

Ekman, P. (1993). Facial expression and emotion. *American Psychologist, 48,* 384-392.

Ekman, P. (1994). Strong evidence for universals in facial expressions: A reply to Russell's mistaken critique. *Psychological Bulletin, 115*, 268-287.

Ekman, P. (2003). *Emotions revealed: Recognizing faces and feelings to improve*

doi: 10.1037/emo0000236

communication and emotional life. New York, NY: Times Books.

Ekman, P. (2016). What scientists who study emotion agree about. *Perspectives in Psychological Science, 11,* 31-34.

Ekman, P., & Cordaro D. (2011). What is meant by calling basic emotions. *Emotion Review, 3*, 364-370.

Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology, 17,* 124-129.

Ekman, P., Sorenson, E. R., & Friesen, W. V. (1969). Pan-cultural elements in facial displays of emotion. *Science, 164,* 86-88.

Elfenbein, H. A. (2013). Nonverbal dialects and accents in facial expressions of emotion. *Emotion Review, 5*, 90-96.

Fellows, S. B. (1901). Grammar of the Kilivila dialect (together with a vocabulary), in *Annual Report of British New Guinea 1900-1901*. Brisbane, Australia: Government Printer.

Fernández-Dols, J. M., & Crivelli, C. (2014). Recognition of facial expressions: Past, present, and future challenges. In M. Mandal, & A. Awasthi (Eds.), *Understanding facial expressions in communication: Cross-cultural and multidisciplinary perspectives* (pp. 19-40). New Delhi, India: Springer.

Frank, M. G., & Stennett, J. (2001). The forced-choice paradigm and the perception of facial expressions of emotion. *Journal of personality and social psychology*, *80*, 75-85.

Fridlund, J. A. (1994). *Human facial expression: An evolutionary view*. San Diego, CA: Academic Press.

Frijda, N. H., & Tcherkassof, A. (1997). Facial expressions as modes of action readiness. In J. A. Russell & J. M. Fernández-Dols (Eds.), *The psychology of*

facial expression (pp. 78-102). Cambridge, UK: Cambridge University Press.

Gendron, M., Roberson, D., van der Vyver, J. M., & Barrett, L. F. (2014). Perceptions of emotion from facial expressions are not culturally universal: Evidence from a remote culture. *Emotion, 14*, 251-262.

Gilovich, T., Keltner, D., & Nisbett, R. E. (2011). *Social psychology* (2nd ed.). New York, NY: Norton.

Haidt, J., & Keltner, D. (1999). Culture and facial expression: Open-ended methods find more expressions and a gradient of recognition. *Cognition and Emotion*, *13*(3), 225-266.

Hess, U., & Blairy, S. (2001). Facial mimicry and emotional contagion to dynamic emotional facial expressions and their influence on decoding accuracy. *International Journal of Psychophysiology, 40*, 129-141.

Hothorn, T., Hornik, K., van de Wiel, M. A., & Zeileis, A. (2008). Implementing a class of permutation tests: The coin package. *Journal of Statistical Software, 28*, 1-23.

Izard, C. E. (1971). *The face of emotion.* New York, NY: Appleton-Century-Crofts.

Izard, C. E. (1994). Innate and universal facial expressions: Evidence from developmental and cross-cultural research. *Psychological Bulletin, 115*, 288-299.

Jack, R. E., Blais, C., Scheepers, C., Schyns, P. G., & Caldara, R. (2009). Cultural confusions show that facial expressions are not universal. *Current Biology, 19,* 1543-1548.

Kabakoff, R. I. (2015). *R in action: Data analysis and graphics with R* (2nd ed.). Shelter Island, NY: Manning.

Kayyal, M. H., & Russell, J. A. (2013). Palestinians and Americans judge spontaneous facial expressions of emotion. *Emotion, 13*, 891-904.

doi: 10.1037/emo0000236

Kollareth, D., & Russell, J. A. (2016). The English word disgust has no exact translation in Hindi or Malayalam. *Cognition and Emotion, 30,* 1-12.

Leach, J. W., & Leach, E. R. (1983). *The Kula: New perspectives on Massim exchange.* Cambridge, UK: Cambridge University Press.

Levenson, R. W. (2011). Basic emotion questions. *Emotion Review, 3*, 379-386.

Leys, R. (2010). How did fear become a scientific object and what kind of object it is? *Representations, 110,* 66-104.

Malinowski, B. (1965). *Coral gardens and their magic: A study of the methods of tilling the soil and agricultural rites in the Trobriand Islands, vol. 1 and vol. 2.* New York, NY: American Books. (Original work published 1935)

Malinowski, B. (1969). *The sexual life of savages in North-Western Melanesia.* New York, NY: Harcourt, Brace and World. (Original work published 1929)

Myers, D. G., & DeWall, C. N. (2015). *Psychology* (11th ed.). New York, NY: Worth.

Naab, P. J., & Russell, J. A. (2007). Judgments of emotion from spontaneous facial expressions of New Guineans. *Emotion, 7*, 736-744.

Nelson, N. L., & Russell, J. A. (2016). A facial expression of pax: Assessing children's "recognition" of emotion from faces. *Journal of Experimental Child Psychology, 141,* 49-64.

Ojalehto, B. L., & Medin D. L. (2015). Perspectives on culture and concepts. *Annual Review of Psychology, 66,* 249-275.

Plamper, J. (2015). *The history of emotions: An introduction*. Oxford, UK: Oxford University Press.

R Core Team (2014). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from http://www.r-project.org

doi: 10.1037/emo0000236

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39,* 1161-1178.

Russell, J. A. (1994). Is there universal recognition of emotion from facial expression? A review of the cross-cultural studies. *Psychological Bulletin, 115*, 102-141.

Russell, J. A. (1995). Facial expressions of emotion: What lies beyond minimal universality? *Psychological Bulletin, 118*, 379-391.

Russell, J. A. (1997). Reading emotion from and into faces: Resurrecting a dimensional-contextual perspective. In J. A. Russell & J. M. Fernández-Dols (Eds.), *The psychology of facial expression* (pp. 295-320). New York, NY: Cambridge University Press.

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review, 110,* 145-172.

Schacter, D. L., Gilbert, D. T., & Wegner, D. M. (2011). *Psychology* (2nd ed.). New York, NY: Worth.

Senft, G. (1986). *Kilivila: The language of the Trobriand Islanders*. New York, NY: Mouton de Gruyter.

Senft, G. (1998). Body and mind in the Trobriand Islands. *Ethos*, 26, 73-104.

Senft, G. (2010). *The Trobriand islanders' ways of speaking*. New York, NY: Mouton de Gruyter.

Sorenson, E. R. (1975). Culture and the expression of emotion. In T. R. Williams (Ed.), *Psychological anthropology* (pp. 361-372). Chicago, IL: Aldine.

Sorenson, E. R. (1976). *The edge of the forest: Land, childhood, and change in a New Guinea protoagricultural society*. Washington, DC: Smithsonian Institution Press.

Sorenson, E. R., Claessen, H. J. M., du Torr, B. M., Griffith, J., Hockings, P., Jablonko,

doi: 10.1037/emo0000236

A., … Watson, J. B. (1972). Socio-ecological change among the Fore of New Guinea. *Current Anthropology*, *13*, 349-383.

Wagner, H. L., MacDonald, C., & Manstead, A. (1986). Communication of individual emotions by spontaneous facial expressions. *Journal of Personality and Social Psychology, 50,* 737-743.

Widen, S. C. (2013). Children's interpretation of facial expressions: The long path from valence-based to specific discrete categories. *Emotion Review, 5,* 72-77.

Widen, S. C., & Russell, J. A. (2008). Young children's understanding of other's emotions. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (3rd ed., pp. 348-363). New York, NY: Guilford Press.

Widen, S. C., & Russell, J. A. (2010). Differentiation in preschooler's categories for emotion. *Emotion, 10,* 651-661.

Wierzbicka, A. (1999). *Emotions across languages and cultures: Diversity and universals.* Cambridge, UK: Cambridge University Press.

Wierzbicka, A. (2014). *Imprisoned in English: The hazards of English as a default language.* New York, NY: Oxford University Press.

Yik, M., Widen, S. C., & Russell, J. A. (2013). The within-subjects design in the study of facial expressions. *Cognition and Emotion, 27*, 1062-1072.

Young, M. W. (1998). *Malinowski's Kiriwina: Fieldwork photography 1915-1918.* Chicago, IL: University of Chicago Press.

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Table 1
Proportion of Trobrianders Providing Each Label for Five Fore Spontaneously Produced Faces, Study 1

	Labels		
Faces	Kilivila	English	P
Happiness	Gigila, togigila	Laughing, smiling	.44*
	Mwasawa	Happiness, play	**.13**
	Mwamwasila	Magic of attraction, radiance	.13
	Bwena, boina, bo bwena	Good	.09
	Gibulwa	Feels like avoiding social interaction	.06
	Gala anukwali	I don't know	.06
		Idiosyncratic	.09
Sadness	Gibulwa	Feels like avoiding social interaction	.22
	Gala anukwali	I don't know	.19
	Ninamwau, mwau	Sadness	**.16**
	Bwena, boina, bo bwena	Good	.09
	Ekatowla	Sick	.09
	Kokola	Fear	.06
		Idiosyncratic	.19
Anger	Gibulwa	Feels like avoiding social interaction	.56*
	Ekabelu	Wry face	.09
	Ninamwau, mwau	Sadness	.06
	Bwena, boina, bo bwena	Good	.06
	Gala anukwali	I don't know	.06
		Idiosyncratic	.16
Surprise	Gibulwa	Feels like avoiding social interaction	.19
	Ninamwau, mwau	Sadness	.16

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	Gala anukwali	I don't know	.16
	Bwena, boina, bo bwena	Good	.09
	Ekatowla	Sick	.06
	Kaikai wowola, lawari	Worried	.06
		Idiosyncratic	.28
Disgust	Gibulwa	Feels like avoiding social interaction	.22*
	Gala anukwali	I don't know	.19
	Ninamwau, mwau	Sadness	.09
	Minena	Disgust	**.06**
	Gaga	Bad	.06
	Mayuyu	Pain	.06
	Ekabelu	Wry face	.06
	Ekasigegina	Snarling	.06
	Ekalimisimisi, Ekamakwesi	Rejecting, refusing	.06
		Idiosyncratic	.16

Note. $N = 32$. Proportions are rounded up. Results for predicted terms in bold. Kilivila (Senft, 1986) is the Austronesian language spoken in the Trobriand archipelago. Asterisks represent chi-square goodness-of-fit tests' standardized residuals higher than 2 *SD*. Idiosyncratic = Labels provided once (proportion < .04). Only one Trobriander provided the predicted term (*leya*, anger) for the angry face.

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Table 2
Proportion of Trobrianders and U.S. Americans Rating a Set of Fore Faces on Core Affect Measures, Study 1

		Society				
Faces	Core affect	Trobrianders	U.S. Americans	X^2	*p*	95% CI
			Valence			
Happiness	+	.75**	.65*	0.55	.457	[-.11, .29]
	−	.25	.35			
Sadness	+	.31	.00			
	−	.69*	1.00***	16.76	<.001	[-.49, -.18]
Anger	+	.19	.00			
	−	.81***	1.00***	9.16	.003	[-.35, -.09]
Surprise	+	.28	.17			
	−	.72*	.83***	0.50	.481	[-.32, .11]
Disgust	+	.00	.00			
	−	1.00***	1.00***	n/a	n/a	n/a
			Arousal			
Happiness	+	.75**	.73**	0.01	.999	[-.19, .22]
	−	.25	.27			
Sadness	+	.88***	.61	5.36	.021	[.07, .44]
	−	.13	.39			
Anger	+	.94***	.57	11.14	<.001	[.19, .53]
	−	.06	.44			
Surprise	+	.88***	.55	7.38	.007	[.12, .51]

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	−	.13	.45			
Disgust	+	.19	.80***	25.88	<.001	[-.76, -.40]
	−	.81***	.20			

Note. Proportions are rounded up. Stimuli could either be rated as positive (+) or negative (−) on the dimensions of valence and arousal. Asterisks represent right unilateral binomial tests' *p* values ($\pi = .50$). CI = confidence interval.
*$p < .05$ (one-tailed)
**$p < .01$ (one-tailed)
***$p < .001$ (one-tailed)

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Table 3
Proportion of Trobrianders Matching a Face to an Emotion Label, Study 2

	Labels										
	Happiness	Sadness	Anger	Surprise	Disgust						
Faces	*Mwasawa*	*Ninamwau*	*Leya*	*Eyowa lopola*	*Minena*	*Gigila*	*Gibulwa*	Other	I don't know	χ^2	*p*
Happy	**.17**	.13	.00	.00	.00	.67*	.00	.00	.04	81.75	<.001
Sad	.04	**.29**	.17	.17	.04	.00	.13	.04	.13	14.25	.078
Angry	.00	.29*	**.13**	.04	.04	.00	.50*	.00	.00	52.05	<.001
Surprised	.13	.21	.04	**.21**	.04	.00	.17	.13	.08	9.75	.306
Disgusted	.00	.04	.13	.04	**.38***	.00	.33*	.04	.04	35.25	<.001

Note. $N = 24$. Proportions are round up. Results for predicted terms in bold. To obtain *p* values, chi-square goodness-of-fit tests were computed on rows by bootstrapping 10,000 replicates for simulation. *Gigila* = Laughing, smiling. *Gibulwa* = Feels like avoiding social interaction.
* Values with standardized residuals higher than 2 *SD*.

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Table 4
McNemar Tests for Labels Across Faces

	Labels						
Faces	Happiness	Sadness	Anger	Surprise	Disgust	*Gigila*	*Gibulwa*
Happy	$.17_{b}$	$.13_{ab}$	$.00_{a}$	$.00_{a}$	$.00_{a}$	$.67_{b}$	$.00_{a}$
Sad	$.04_{ab}$	$.29_{b}$	$.17_{b}$	$.17_{b}$	$.04_{a}$	$.00_{a}$	$.13_{ab}$
Angry	$.00_{a}$	$.29_{b}$	$.13_{ab}$	$.04_{ab}$	$.04_{a}$	$.00_{a}$	$.50_{c}$
Surprised	$.13_{ab}$	$.21_{ab}$	$.04_{ab}$	$.21_{b}$	$.04_{a}$	$.00_{a}$	$.17_{b}$
Disgusted	$.00_{a}$	$.04_{a}$	$.13_{ab}$	$.04_{ab}$	$.38_{b}$	$.00_{a}$	$.33_{bc}$

Note. Proportions are rounded up. Proportions with different subscripts in the same column differed significantly at $p < .05$ according to McNemar tests. *Gigila* = laughing, smiling. *Gibulwa* = feels like avoiding social interaction.

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Table 5
Estimated Difference of Proportions Between Basic Emotion Theory's Predicted Label and Study 1's Modal Labels

	Labels			
Faces	BET	Study 1's modal	*p*	95% CI
Happiness	.17	.67	.001	[-.77, -.25]
Sadness	.29	.13	.287	[-.08, .40]
Anger	.13	.50	.011	[-.64, -.11]
Surprised	.21	.17	.999	[-.19, .27]
Disgust	.38	.33	.999	[-.25, .33]

Note. Proportions are rounded up. *P* values and 95% CIs for the difference of matching scores' proportions between Basic Emotion Theory and Study 1's modal labels were computed through two-sample permutation tests. The distribution under the null hypothesis was computed from all possible permutations. Study 1's modal labels were *gigila* (laughing, smiling) for the happy faces and *gibulwa* (feeling like avoiding social interaction) for sad, angry, surprised, and disgusted faces. BET = Basic Emotion Theory. CI = confidence interval.

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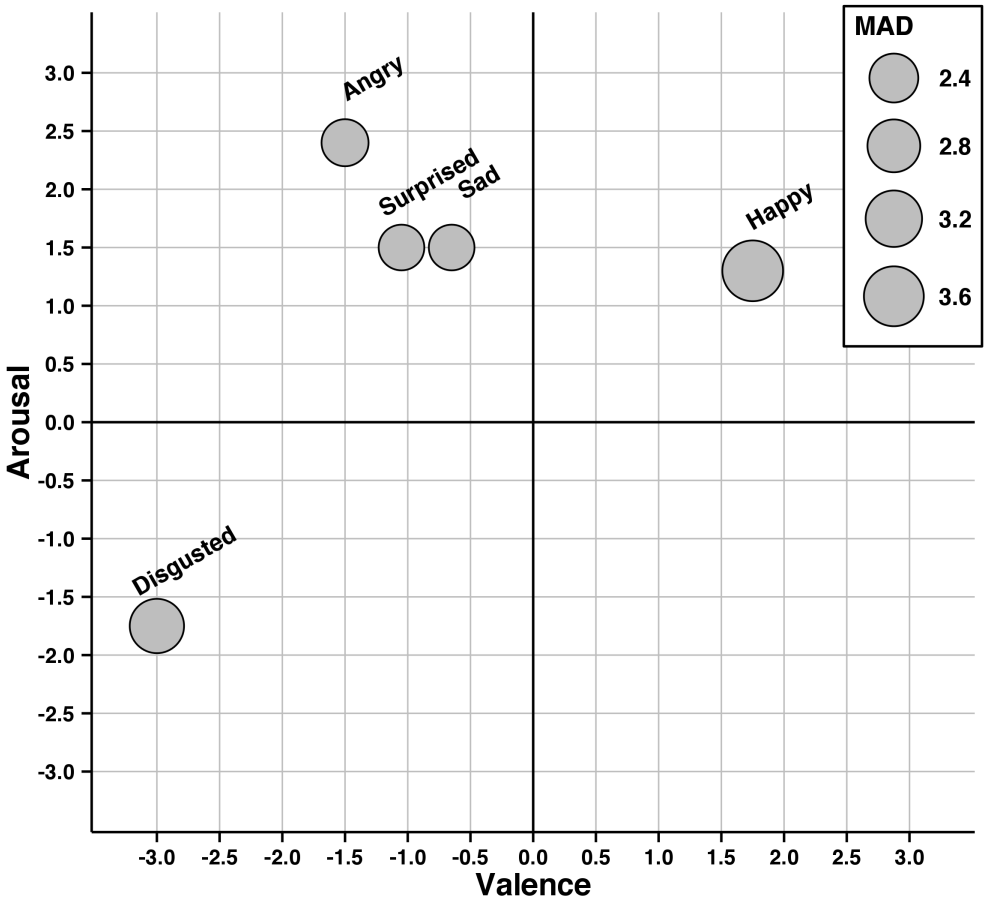

Figure 1. Balloon plot showing Trobrianders' 20% trimmed means for valence and arousal ratings of facial expressions of "emotion" spontaneously produced by Fore members. The size of the plotted points represent a nonlinear transformation of the median absolute deviation (MAD) computed for valence and arousal ratings.

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Appendix

Stimulus Set and Raw Data from Study 1

Table A1
Stimulus Set for Study 1 and Study 2

Ekman's (1980) prediction	Plate	Action units
Happy	37B	2L + 7 + 12 + 25
Sad	14	1 + 4 + 5 + 7
Angry	17	4 + 5 + 7
Surprised	7	1 + 2 + 4 + 25
Disgusted	16	4 + 6 + 9 + 10

Note. Plate = the identification number provided by Ekman (1980) for the selected Fore facial expressions. Action units = an anatomical coding system to identify and describe facial muscles' contractions as coded by Ekman, Friesen, & Hager's (2002) Facial Action Coding System (FACS). We randomly selected one picture from the two available happy (plates 37B and 8f) and surprised (plates 7 and 8m) faces.

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Table A2
Number of Subjects Providing an Emotion Label for a Set of Fore Faces

Labels		Faces				
English	Kilivila	Happiness	Sadness	Anger	Surprise	Disgust
Happiness, play	Mwasawa	4	0	1	0	0
Sadness	Ninamwau, mwau	1	5	2	5	3
Anger	Leya	1	0	1	0	1
Surprise	Eyowa lopola	0	0	0	0	0
Disgust	Minena	0	0	0	0	2
Laughing, smiling	Gigila, togigila	14	0	0	0	0
Avoiding social interaction	Gibulwa	2	7	18	6	7
I don’t know	Gala anukwali	2	6	2	5	6
Good	Bwena, boina, bo bwena	3	3	2	3	0
Bad	Gaga	0	0	1	1	2
Magic of attraction, radiance	Mwamwasila	4	1	1	1	0
Fear	Kokola	0	2	0	1	1
Pain	Mayuyu	0	1	0	0	2
Sick	Ekatowla	0	3	1	2	0
Wry face	Ekabelu	0	0	3	0	2

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Snarling	Ekasigegina	0	0	0	1	2
Crying	Evalam	1	0	0	1	0
Confused	Enakaka	0	0	0	1	0
Embarrassment	Mwasila	0	0	0	1	0
Headache	Gedageda dabala	0	0	0	0	1
Worried	Kaikai wowola, lawari	0	0	0	2	0
Looking	Egigisa	0	1	0	0	0
Rejecting, not wanting	Ekalimisimisi	0	0	0	0	1
Doubting	Ewowoya	0	1	0	0	0
Opening wide the eyes	Etolatola matala	0	0	0	1	0
Rejecting, refusing	Ekamakwesi	0	0	0	0	1
Shut up	Ekapatu	0	0	0	1	0
Smart, healthy	Salau	0	1	0	0	0
Squint	Emitupayuyu	0	0	0	0	1
Bored	Kalanunumata	0	1	0	0	0

Note. Kilivila (Senft, 1986) is the Austronesian language spoken in the Trobriand archipelago.